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EXAMINER	
PADGETT, MARIANNE L	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	10/807,680	WU ET AL.
	Examiner	Art Unit
	Marianne L. Padgett	1792

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 3/23/4,3/2/5,6/22/5,8/24/5,10/19/5,12/19/05, 2/27/06, 4/24/06, 7/25/06, 11/13/06, 4/30/07 & 7/23/07

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-40 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-40 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date See Continuation Sheet.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Continuation of Attachment(s) 3). Information Disclosure Statement(s) (PTO/SB/08), Paper No(s)/Mail Date :3/2/5, 6/22/5, 8/24/5, 10/19/5, 12/19/5, 2/27/6, 4/24/6, 7/25/6, 11/13/6, 4/30/7, 7/23/7.

1. The 11 information disclosure statements submitted by applicants are made of record, and it is noted that as office actions, which are part of an application's file, are not published documents, so the listing of such actions on the PTO-1449 is not appropriate, however the examiner is considering such listings as citation of specified application, which is appropriate, and cited applications have been reviewed for relevance to the present application, where that review properly includes reviewing prosecution history when claims are sufficiently relevant. The signed & initialed PTO-1449's from other applications, which applicants improperly included, are not considered to be & have not been considered as citations in this application. Note that citation of an application can be considered to be analogous to citation of a patent or published application, thus is appropriately identified by application number, inventive entity & filing date.

Note in the 6/22/2005 IDS, the literature reference by Peter Singer is incomplete, because the right sides of all of the pages have been cut off, so that the reference cannot be fully evaluated due to the defective copy supplied.

2. The examiner notes that page 2 of the specification, in the second paragraph of the background, particularly on lines 13-14, **defines** "Low k dielectrics" as "those materials that have a dielectric constant lower than that of silicon dioxide, that is k < 4", hence the use of this term in the claims & the rest of the specification is not considered relative, but to have this defined meaning.

3. Claims 1-40 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 1, the limitations of (a) & (b) are directed to processing of the "the precursor film", however this film is never clearly related to the "porous low-k dielectric film" that is introduced in the preamble & treated in (c), thus there is no clear connection between limitations (a)-(b) & limitation (c), or between the two named films introduced in this claim. Independent claim 36 has analogous problems

with respect to the nomenclature of the film & layer, discussed in limitations (a)-(b) & limitation (d), but in this case the limitation of (c) provides a relationship between the actions involving the movement of the substrate, although it still lacks a clear relationship between the "precursor film" & the "porous low-k dielectric layer".

With respect claim 5, the examiner notes that "silane" is a generic term that totally encompasses both alkylsilane & alkoxysilane, such that these 2 species are not mutually exclusive from silane & the Markush group is technically improper. Similarly in claim 6, the species of TMSA appears to totally encompass the species of BTMSA, such that they are also not mutually exclusive.

In claim 8 (dependent from claim 7), the scope of "a piene compound" is unknown, as no explanation of what these compounds are was found in the specification, as the disclosure of these claimed porogens on page 4, lines 26-27 merely states "Examples of such compounds are pienes such as beta-piene and alpha-piene", without giving any identifying structure. Review of chemical dictionaries, such as Hawley's Condensed Chemical Dictionary, 12th edition (p. 916-917) does not recognize the existence of any such compounds, however the examiner notes that functionalized cyclic compounds called terpinenes (p. 1123-1124) have a polyfunctional cyclic non-aromatic structure as required by claim 7, and as noted in Lukas et al. (2004/0096672 A1) in paragraph [0043], alpha-terpinene is known for use as a porogen, which makes the examiner suspect applicants may have intended some compounds such as terpinenes, however alpha-piene cannot accurately be said to mean alpha-terpinene without a clear showing of such. The examiner notes further discussion of porogen compounds on page 10, where the inserted table between lines 17 & 20, mentions terpinene compounds (e.g., alpha terpinene) as do lines 22-24, with separate mention of "pinene compounds, including alpha and beta pinene isomers" on lines 21-22 of page 10, where p. 918 of the dictionary defines α- & β- pinene as $C_{10}H_{16}$ that are terpene hydrocarbons, however these also are not what is actually claimed. Given that terpinenes compounds are cyclic terpenes, and that it appears probable that the claimed "piene" is probably a misspelling or typo-

graphical error for "pinene" (also a terpene, but **not necessarily** cyclic) as evidenced by page 10 of the specification & dictionary, for purposes of examination over prior art, the uncertain terms of "piene" will be so treated.

In claim 16, the scope of the limitation may be considered unclear or ambiguous in that "the plasma...comprises hydrogen, helium, argon, nitrogen, carbon dioxide gas or a combination thereof" might be considered that the "gas" only applies to carbon dioxide, or alternately might be intended for the gas to apply to all the preceding options which would have a different scope for hydrogen & nitrogen, because in the first case the plasma could employ any source of hydrogen or nitrogen, while in the latter case H_2 & N_2 would be indicated, thus the scope of this claim is uncertain. For purposes of examination, the broadest possibility will be considered, such that claim 16 will be considered to include & read on use in the plasma of any precursors that contain either hydrogen or nitrogen.

Claim 17 is direct to parameters for "the plasma treatment", however this term is inconsistent with the nomenclature of the independent claim 1, which refers to "exposing...to a plasma..." in (b) & to "treating the substrate..." in (c), but with no mention of plasma, such that the limitation in claim 17 can be said to have partial or uncertain references to two different steps, so that it is unclear as written to which action the phrase necessarily references. Since "plasma" is the more important of the words in the phrase, the examiner assumes that the intent was probably to modify the limitation of (b), however clarity in the claim language is needed.

In claim 18, "the chamber pressure" lacks proper & clear antecedent basis, because independent claim 1, from which it depends, introduces 2 specifically named chambers, i.e. a first chamber & a second chamber, and does not introduce any limitations directed to pressure, therefore due to this inconsistency, it is unclear where the claimed pressure is intended to be employed. Also, does the use of the verb "ranges" mean that the pressure, in whatever chamber, is changing during processing between the given values, or was the intent to employ a value somewhere within the claimed values?

Claim 23 as phrased sheds doubt on the meanings of "a first chamber" & "a second chamber" in the independent claim 1, as these limitations would appear to be newly requiring two different chambers be employed, hence the phrasing in claim 23 when it states "the first and second chambers are in separate chambers..." might be construed to mean in the independent claim 1, that the first chamber may be identical to the second chamber, if this is not the intent then such is the terminology used therein is misleading. Alternately, claim 23 might only be intended to indicate that these two separate chambers are in the same "multi-chamber apparatus". If the latter option is the intent, would rephrasing claim 23 to read -- wherein the first and second chambers are both in a multi-chamber apparatus --, or using language such as "separate" in describing the chambers in the independent claim provide applicants' intent?

In claim 25, the claim of repeating (a) & (b) is said to "build up a desired thickness of the precursor film before (c), which would suggest that (b) does not produce "the porous low-k dielectric film", which one might guess is intended to be formed in claim 1(b) from the exposing, which removes a substantial portion of the porogen from the precursor film, but which is made uncertain by the above discussed lack of clear relationship between the two films discussed in claim 1. Claim 25 can be considered to further confuse the issue. Note claim 38 has analogous problems.

In claims 24 & 36 (preamble), what exactly does "vacuum integrated" mean with respect to the chambers? Any reduced pressure apparatus that employs a vacuum system or systems to provide reduced pressure in a chamber or plural chambers, must somehow have that vacuum system(s) "integrated" with the chamber(s) in order for the reduced pressure function of the apparatus to be effective with respect to the chamber. Is this terminology supposed to mean something other than or more specific than the phrasing would literally indicate, which is a concept that would've been expected in any vacuum apparatus having any chambers that are evacuated?

In claim 38 "the precursor layer" lacks antecedent basis as the nomenclature used therein is inconsistent with that of independent claim 36, which refers to "a precursor film", thus the relationship of

the precursor film & the precursor layer is uncertain.

4. The disclosure is objected to because of the following informalities: where copending cases are mentioned in the specification, the data concerning these applications needs to be updated, especially see those sections of the specification, such as pages 1, 3, 16 & 18, where blanks have been left in which serial numbers need to be provided.

Appropriate correction is required.

5. Claims 8 & 11 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

The specification lacks adequate enablement to determine what piene compounds, such as alpha-piene, are, hence what scope of compounds is claimed. See above discussion in section 3.

Claim 11 requires the first chamber to contain apparatus for the claimed spin-on deposition process, as well as for plasma treatment of the deposited precursor film, and while the specification discloses the possibility of employing spin coating processes (page 9, line 5 & page 12, line 30) in applicants' invented process, which emphasizes & expresses a preference for depositing in the same chamber as plasma treatment to remove porogen occurs (page 9, lines 14-19; page 12, lines 20-page 13, line 10; & figure 1); the specification never actually provides an explicit combination thereof or any examples of the spin coating in a plasma chamber, nor any means for combining these two different mechanisms, which generally require different processing conditions, in the same chamber. Furthermore, the examiner notes that teaching such as on page 9 stating "In **many embodiments** of this invention, a significant amount of porogen in a precursor layer is removed by exposure to a plasma within the same chamber in which the layer is formed" (emphasis added), implies that the layer deposition need not actually be in the same chamber as preforms the plasma porogen removal, as all in body that is of the

invention need not do this. This contention is also supported by the sentence bridging pages 12-13, where the specification particularly states "However, **when** the initial porogen removal involves a plasma treatment in the chamber where the deposition took place, a PECVD process is generally preferred" (emphasis added). In fact, all actual examples or details in the specification that provide teachings in a single chamber concerning particular types of deposition & plasma treatment to remove porogens involve chemical vapor deposition processes, almost always plasma, where no enablement was found to combine a liquid deposition process, such as spin-on coating, in the same chamber as plasma treatment is performed. Particularly see the exemplary discussion of figure 1 starting on page 13; the discussion of the apparatus employed starting on page 16 & particularly discussion of figure 2 (first chamber = PECVD chamber 203) starting on page 17; & experimental data on pages 20-22 which is uniformly directed to vapor deposited precursor films, mostly PECVD, that are then plasma treated.

For these reasons there does not appear to be adequate enablement for performing spin-coating in the same chamber as plasma treatment of the deposited film is performed, unless such a combination can be considered so obvious that no examples or details (hence no references either) are needed to enable or suggest the use of these techniques in a single chamber.

6. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg,* 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman,* 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi,* 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum,* 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In*

re Vogel, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. Claims 1-6, 11-12, 15-18, 21-24, 26-27, 32-37 & 39-40 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1, 4-8, 11-12, 25-26, 30-32, 35 & 37 of U.S. Patent No. 7,166,531 (≡ SN 11/050621). Although the conflicting claims are not identical, they are not patentably distinct from each other because the claims have significant overlap in their scope as both sets of claims may deposit a dielectric precursor mixture, which comprises a porogen & a structure former (≡ dielectric network), that may be deposited together & via techniques,

such as spin-on deposition, and may be inclusive of material such as various silicon oxides & silicate glass, where this composite material is treated to remove at least some of porogen, with possible porogen removal techniques of the patent including use of a plasma, thus overlapping in scope with the present application. Both sets of claims treat the deposited dielectric film in order to strengthen the layer, where treatment techniques include UV or electron beam (EB) radiation, and it is noted that while the patent claims list the treating limitation before the porogen removal limitation, the treating step in the patent is not necessitated to be performed at any specific time in relationship to the porogen removal, and clearly as indicated by claim 12 can be after the removal, as claim 12 reads on performing (b) any time after step (c). The claims of the patent differ by including extra processing steps not required to be present application, however the steps are not excluded by the present claim techniques. The patent claims also differ by not specifying that the porous dielectric network is low-k, however porous dielectric materials typically are low-k dielectric materials, hence one of ordinary skill in the art would have expected materials described in the patent to fit the general definition of $k<4$, since porous silicon dioxide dielectric layers generally have lower dielectric constants than dense silicon dioxide, as that is one of the reasons therefore.

The patent claims also differ by not discussing the chamber structure of the apparatus in which the sequences of patented steps are preformed, however it would have been obvious to anyone of ordinary engineering skill & competence to perform a multistep process using more than one chamber , especially when steps being performed require different equipment that produce different area effects & different conditions, such as energy input (i.e. plasma versus UV or EB), particularly if the process sequence is intended to be used for any sizable quantity of production in industry, since that would have been expected to be more efficient, more cost-effective to enable continuous processing, where processes in the sequences which might interfere with each other would be required to be performed in separate chambers in order to separate the conditions under which they were performed. While the patent claims do not

discuss deposition, such as suggested spin-on deposition processes, to be done in the same chamber as the claimed plasma treating that removes porogens, since for the present application claims as read in light of the specification might be considered so obvious as to not need explicit teaching of this combination nor any teachings on how such a combination of treatment means would be employed in the same chamber, the concept may be considered similarly obvious with respect to the patent claims.

It is noted that while the patent also does not discuss use of a robot wafer handler, the type of film deposition processes recited in both sets of claims are typically preformed automatically, hence use of robotic substrate handlers would have been expected to be an obvious option for shifting substrates from one treatment step to the next as they are a typical techniques for handling/moving/placing discrete substrates, thus would have been an obvious option when performing the patented techniques on individual substrates, such as wafers that are typically employed in the electronic & semiconductor industry where porous low-k dielectric films are typically used.

While the patent claims include both treating with the UV or EB, & exposing to plasma to remove at least a portion of the porogen, they do not claim any particular parameters used to do so, however it would've been obvious to one of ordinary skill in the art to employ routine experimentation to determine desirable parameters for these processes that would have been dependent on particular materials employed, both for forming dielectric structure & as the porogen to be removed, where it is further noted that as none of the specifically claimed parameters are directed to use with any particular material, they have little to no significance, since the techniques are directed to treating generic categories of materials. It is further noted that gases, such as helium, argon & nitrogen, are typical plasma gasses, such that at least one of these gases would have reasonably been expected to be present in a plasma removal techniques whether it was based on physical or chemical action of the plasma, used by itself or in combination with other gases. Also note with respect to amount of porogen removal ranging from about 5-90% that this range encompasses almost all possible amounts such that one of ordinary skill in the art

would have expected the claimed "removing at least some of porogen" of the patented claims to have affected removal of porogens in values encompassed by this range.

8. Claims 1-6, 9, 11-12, 15-24, 26-37 & 39-40 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1, 3-7 & 10-19, 21, 23-24, 25- 28 of U.S. Patent No. 7,176,144 (≡ SN 10/785,235). Although the conflicting claims are not identical, they are not patentably distinct from each other, because while claiming limitations in different scopes/orders, the claims has significant overlap in their scope, as both sets of claims may deposit a low-k dielectric mixture, which comprises a porogen & a structure former (≡ dielectric matrix), that may be deposited together & via techniques, such as vapor deposition or spin-on deposition, where the claimed processes use different stations on a multistation tool, and may deposit material inclusive of various silicon & oxygen deposits derived from materials, such as OMCTS or TMCTS, where this composite material is treated to remove at least some of porogen, where possible porogen removal techniques of both cases use plasma. Also, both cases employ additional treatment with UV, where this additional treatment also may remove at least some porogen. The patented claims of (144), as set forth in independent claim 25 & its dependent claim 26 do not specify whether the UV treatment, which also removes porogens, is before or after the plasma treatment that removes porogens, only that it is before the plasma treatment that deposits the silanol layer, which is after the plasma porogen removal step, however as both of these steps are partially removing porogens from the precursor layer, it is clear that these patented claims encompasses either order of treatment, i.e. plasma then UV or UV then plasma, hence encompassing the order of the present claims.

While the patent claims do not specify use of separate chambers for plasma & UV radiation techniques, it would have been obvious to one of ordinary skill in the art to perform the sequential steps in different chambers in order to be able to optimize the parameters of these different porogen removal techniques in order to most effectively & efficiently apply the energy to create the desired porosity.

Whether or not one of ordinary skill in the art would have considered performing the plasma exposing in the same chamber that one performs the precursor layer deposition, would have depended on the effect on the throughput of employing the same chamber, the similarity of the conditions required for the deposition & the plasma treatment, the effects of moving the substrate with the precursor layer deposited thereon before exposing to plasma, etc., where it is noted that plasma treatment is a paper process, thus particularly compatible with the claimed CVD techniques & that as discussed above in light of applicants' specification as written spin coating combined in a chamber with plasma treatment might be considered so obvious as to not need any further disclosure.

Arguments concerning obviousness of use of robot arms & routine experimentation for determining useful process parameters are also considered obvious with (144) for reasons as discussed above in section 7.

9. Claims 1-18, 20-24, 26-37 & 39-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lukas et al. (2004/0096672 A1), (6,268,288 B1).

Lukas et al. ((672); abstract; [0011-12+]; [0021-23]; [0025]) teach deposition of low dielectric materials ($k \leq 2.7$, more preferably about $k \leq 2.2$, [0069]; organosilicates glass, [0022] [0025] [0051]) by deposition of multiphasic material that may codeposit a pore-forming material (i.e. porogen, such as α-terpinene; [0043] & [0078]) & a structure forming material (DEMS, TMCTS, OMCTS, TMSA; [0030] & [0078]) using deposition techniques, such as CVD, PECVD, spin coating, etc. ([0027-28] & [0032]), where it is further taught to remove the pore-forming phase by exposure to at least one energy source, inclusive of UV light, electron beams, plasmas, etc ([0047]; [0053-56]; [0059-60]; [0063- 66]). It is taught that the exposure step may be performed in a variety of settings depending on the process used to form the multiphasic film, including mention of a modified deposition chamber ([0058]). While the teachings of Lukas et al. (672) emphasize the use of deal to violet light source for removal of porogen, they do specifically teach that more than one energy source, where only one need be ultra violet may be

used to perform this step, they also explicitly teach a further "treatment" step that "may be performed before, during, or after the exposing step", that may increase the mechanical integrity of the material, by for example promoting crosslinking within the porous film, stabilizing the porous film and/or removing additional chemical species from the network, and where this second energy source includes any of the energy sources disclosed in the reference ([0059-60, especially 60]). Lukas et al. note that various parameters, such as temperature, time may vary depending on the chemical species used in the multiphasic material, also with greatly varying conditions with respect to pressure, vacuum, gaseous environment used (inert e.g. nitrogen, carbon dioxide, He, Ar...; oxidizing; reducing e.g. hydrogen...), pressures preferably about 1-1000 Torr, where these concepts are applied generically regardless of energy source for exposure &/or treatment ([0057-58]; [0061]). With respect to treatments & exposures, for embodiments specifically employing plasma, specific teachings to use environment such as nitrogen, carbon dioxide, He, Ar, or hydrogen gas, at plasma powers of 0-5000 W, preferred temperature ranges from ambient-500°C, preferred pressure ranges of 10 mtorr-atmospheric pressure & preferred total treatment times of 0.01 minutes-12 hours ([0063]). With respect to treatments & exposures, for embodiments specifically employing UV ([0059] & [0064]) various UV wavelengths are mentioned, including using more than one wavelength within the UV spectra with specific mention of ≤280 nm & ≤200 nm; temperatures of 200-250°C or ambient-500°C; power from 0-5000 W & times of 0.01 minutes-12 hours.

It is noted that while Lukas et al. (672) exemplifies a preference for use of ultraviolet light for removal of their porogens, they also exemplify a preference for using multiple energy treatments, both of which may remove porogen forming material & any of the energetic techniques used therefore may enhance mechanical strength as presently claimed. Furthermore since their teachings include orders of performing steps that include a treatment that may be plasma preformed before a UV treatment or exposure, applicants' apparent claimed sequence of steps with respect to plasma & UV, including their

affects are encompassed by the teaching of Lukas et al. Also while the taught parameter ranges are not identical, they are significantly overlapping, especially considering teachings of Lukas et al. concerning parameters used being dependent on materials employed, hence it would've been obvious to one of ordinary skill in the art to be applied routine experimentation dependent on particular materials & types of energy employed for treatments/exposures, in order to optimize for particular energy sources and materials, as well as desired and results. Applicant's claims with respect to the plasma differ in claim 20 by specifying an RF frequency source, whereas Lukas et al. is generic with respect to what type of plasmas are employed, thus one of ordinary skill in the art would have been expected to employ conventional & standard plasma techniques, of which are of plasmas are a typical type, thus an obvious genre of plasmas to employ given the generic disclosure as such would have been expected to be effective in the taught process. With respect to UV radiation, while wavelengths as claimed are recited in Lukas et al., & intended to be used for removal of porogen materials, the disclosure of Lukas et al. does not explicitly say that the porogens absorb the wavelengths employed, however it would've been obvious to one of ordinary skill and competence in the art, that if one is intending to employ specific wavelengths for removal of specific materials, that it would have been necessary for the materials that are to be removed by the UV radiation to able to be affected by that UV radiation, where the typical & generally employed techniques for causing such an effect is to pick a wavelength absorbed by the material desire to be affected, i.e. removed, hence to do such would have been an obvious means to affect the taught process.

Applicants' claims differ from Lukas et al's teachings by requiring the formation of the precursor film comprising a porogen & a structure former to be in the same chamber in which exposure to plasma takes place, and where treating to increase mechanical strength, such as with UV or EB, is performed in a chamber which is ambiguously (see 112 second) a different chamber from the deposition/plasma chamber. Lukas et al. do not require any specific chamber construction or relationship for the multiple energy treatment steps, i.e. plasma, & UV or EB, however their suggestion of employing a modified

deposition chamber for an energy treatment would have been suggested to one of ordinary skill in the art that the initial energy treatment employed may reasonably be expected to be performed in the same chamber as deposition occurs, dependent on particular materials & deposition plus treatment requirements. For example, given taught deposition techniques of PECVD or CVD, and the taught option of employing plasma treatments on the equivalent of the claimed precursor film, it would have been obvious to one of ordinary skill in the art to perform these techniques in the same chamber, dependent on particular manufacturing efficiencies, especially considering employed the same apparatus for consecutive steps may increased cost efficiencies due to the need to buy less equipment & if atmosphere steric, such as pressure conditions are relatively similar, they lack the need to change stations may say time & space, hence combining of consecutive steps would have been expected to have been made where such provides an advantage in time, cost, , etc. efficiencies, depending on which are most critical in the particular manufacturing environment, where such choices would have been expected to have been typically made by a competent managing engineer.

Alternately, Hautala et al. provides teachings concerning sequential CVD deposition followed by plasma treatment all performed in the same chamber (abstract; figure 1; col. 4, lines 20-65+ or CVD & col. 8, lines 21-29 for RF plasma electrodes for the sequential plasma treatment as parts of the CVD chamber), hence Hautala et al. provides an exemplary modified deposition apparatus used for situations as taught by the PGPub of Lukas et al. (672), thus showing the above discussed obviousness & providing further motivation to employ such an efficient apparatus for performing procedures as suggested by the primary reference.

10. Claims 25 & 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lukas et al. (2004/0096672 A1), optionally in view of Hautala et al., as applied to claims 1-18, 20-24, 26-37 & 39-40 above, and further in view of Hautala et al. (6,268,288 B1), optionally considering Jin et al. ("Nanoporous Silica as an Ultralow-k Dielectric", MS bulletin 10/1997) or Han et al. (6,759,098 B2).

Lukas et al. (672) differs from these claims by not suggesting repeated sequences of deposition plasma exposure in order to deposit a desired thickness of either precursor film or porous dielectric film. In their background, Lukas et al. suggest the use of the low dielectric constant materials made by their techniques in the micro electronic industry such as multilayer integrated circuit devices ([0001-3]), with suggestions of use in semiconductor processing ([0081]), but the disclosed process is relatively generic to the deposition without specific enduse, or thicknesses, or the like . Hautala et al., who is analogous to the taught options of the primary reference with respect to CVD or PECVD deposition followed by plasma treatment to affect the deposit (abstract; col. 2, lines 35-48; col. 8, lines 32-47; col. 10, lines 62-col. 11, lines 5+), teach multiple iterations of deposition plasma treatment, for the advantage of good conformity (high formality), improved (uniform) microstructure through the total thickness deposited & low residual impurity concentrations with sufficiently high deposition rates (abstract; col. 2, lines 25-31; col. 10, lines 54-60), hence while Lukas et al. & Hautala et al. are directed to different specific sets of chemical reactions (i.e. different depositions modified by different plasma treatments), it would've been obvious to one of ordinary skill in the art that the generally applicable advantages provided by alternating CVD deposition followed by plasma treatment, which improved the conformality of the deposit as well as ensure even removal of contaminants through the total deposited film, which in the case of Lukas et al. would have been removal of the porogens, would have been expected to provide analogous advantages to deposited films formed of low dielectric constant materials with respect to even removal of their porogens through the thickness of the film, in order to form the porous dielectric films with the analogous advantages taught by Hautala et al., than would have been reasonably expected to be possible if only a single set of steps were performed, where use of such repetitive techniques would depend on desired thicknesses, for the particular product be formed, thus provide greater flexibility in use of the general dielectric deposition techniques for making specific electronic products.

The article to Jin et al. ("Nanoporous...") is optionally considered, as it provides additional motivation for employing the techniques of Hautala et al. of alternate deposition/plasma treatment sequences, if the process of Lukas et al., in order to effect uniform plasma treatment throughout the deposited thickness, thus uniform porogen removal, as such would have been expected to produce uniform porosity throughout the thickness, which as seen in the teachings of Jin et al. (figure 1 discussed in the second full paragraph) would have been expected to affect the particular dielectric constant, hence in order to have uniform dielectric constant through the thickness at of the film, one of ordinary skill in the art would reasonably desire to have uniform porosity, thus providing a further motivation for applying techniques expected to produce such uniformity.

Alternately, Han et al. ((098): abstract; col. 4, lines 19-45; col. 6, lines 10-60 & 66-col. 7, lines 9 & 35-48) is optionally considered to provide additional motivation for multiple alternating depositions with plasma curing which removes material to yield a porous film, as Han et al. teaches the option of plasma curing to reduce the amount of Si-CH_3 bonds to create the porous material which can optionally be further treated, such as by annealing, which may increase the elastic modules, thus affecting a type of mechanical strengthening, where it is taught that this analogously deposited & treated material may be used in an embodiment where one or more of the dielectric layers are formed in order to form a multilayer interconnect structures, thus effectively repeating steps as claimed & providing an additional reason for creating such multilayer structures, which would have been obvious to one of ordinary skill in the art to perform with the above combined teachings of Lukas et al. & Hautala et al., as it is directed to types of and uses as suggested by Lukas et al., hence would have been expected to be useful therefore.

11. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lukas et al. (2004/0096672 A1), optionally in view of Hautala et al. (6,268,288 B1) ., as applied to claims 1-18, 20-24, 26-37 & 39-40 above, and further in view of Laxman et al. (2002/0172766 A1).

The teachings of Lukas et al. (672), optionally considering Hautala et al., do not include suggestions of using duel RF frequency plasma reactors for the plasma exposing step, i.e. for removal of porogen, however Laxman et al. (abstract; [0093- 108, especially 93 & 98-102]; & [0127-128]), who also have teachings directed to preparation of low dielectric constant material, that may be porous, and provide for initial deposition via a CVD process which may be performed using single or dual frequency plasma activation, further teach that after deposition a step that employs alternatively heating or additional plasma activation may be employed to cleave (i.e. remove) volatile components from the deposit, where the plasma apparatus described for the deposition of Laxman et al. would appear to be overlapping in useful types as that employed for Laxman et al.'s post annealing step when plasma enhanced or assisted. Taught radiofrequency sources include radiofrequency sources of about 13.56 MHz using powers ranging from about 75-200 W, or low-frequency (about 350 kHz) sources with power ranging from 5-75 W, or combinations thereof. Given the analogous, but generic, deposition & porogen removal techniques of the primary reference generally inclusive of plasma techniques, it would've been obvious to one of ordinary skill in the art to employ any plasma techniques shown to have been useful for analogous removal processes, such as the dual frequency techniques that are suggested by the teachings of Laxman et al., where it would've been further obvious for one of ordinary skill in the art to perform routine experimentation in order to determine the particular parameters most favorable for the specific materials being deposited & treated via plasma, where one of ordinary skill would recognize that the particular chamber & its characteristics will further affect parameters employed, particularly noting that since Laxman et al. discusses power without providing information concerning area over which that power is applied, hence routine experimentation would have been expected to be necessary in order to determine useful parameter values for a specific plasma apparatus configuration.

12. Other art particularly of interest includes Albano et al. (2002/0106500 A1), who are also making low dielectric constant porous materials with improved elastic modulus & film hardness through

the use of postdeposition treatments of plasma, optionally followed by UV, however this publication indicates that these treatments are applied to material that is already porous, and there's no discussion in Albano et al. (500) concerning either the plasma or the subsequent UV treatment removing any materials equivalent of porogens, however these teachings to provide cumulative evidence of sequential treatments improving mechanical strength and structure of porous dielectric films.

The article to Cho et al. ("Plasma Treatments of Molecularly Templated Nanopores Silica Films") cited by applicants is of interest for spin coating precursors for nanoporous silica films, where oxygen plasma in an plasma enhanced cluster system is employed at 300°C for three minutes to remove organic templates and form the nano porosity, however this reference does not appear to employ a sequential UV treatment.

The patent is to Berry et al. (6,558,755 B2 & 6,576,300 B1) have teachings concerning plasma treating a deposit coding to convert it to a porous silica, followed by a sequential treatment (annealing) that improves properties (elastic modulus) of the initial porous coating, thus overlapping with teachings of Lukas et al. & Hahn et al. applied above & relevant to present claims where the type of specific treatment in the second chamber is not specified.

Other art containing teachings of interest concerning Dole frequency plasma is used with low dielectric constant material processing include shy oh et al. (6479409 B2; see table 1 & conditions listings and cols. 10, 11, 13); Zheng et al. ((2004/0101633 A1); [0020-21]); Hendriks et al. (6,740,602 B1; col.s 8-9); & Chang et al. (6921727 B2; col. 7).

Or 13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Marianne L. Padgett whose telephone number is (571) 272-1425. The examiner can normally be reached on M-F from about 8:30 a.m. to 4:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks, can be reached at (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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